REMARKS

In the last Office Action, the Examiner objected to the drawings as not showing the mathematical model recited in claim 3. Claims 1 and 7 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,547,296 to Iwazawa. Claims 3 and 5 were rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,411,461 to Szita. Claims 2, 6, 8, 9 and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Iwazawa in view of Japanese Patent No. JP02001227825 to Ijira. Claim 4 was objected to as being dependent upon a rejected base claim, but indicated to be allowable if rewritten in independent form including all of the limitations of the base and intervening claims. Additional art was cited of interest.

Applicants and applicants' counsel note with appreciation the indication of allowable subject matter concerning claim 4. However, for the reasons noted below, applicants respectfully submit that amended claims 1-3, 6, 8 and 9 also patentably distinguish from the prior art of record.

In accordance with the present response, allowable claim 4 has been rewritten in independent form to incorporate the subject matter of base claim 3. Independent claims 1-3 have been amended to further patentably distinguish from the prior art of record. Claim 8 has been amended to depend on claim 1. Claim 9 has been amended to provide a clarification

concerning the evaporator. Claims 5, 7 and 10 have been canceled. A new abstract which more clearly reflects the invention to which the amended claims are directed has been substituted for the previously submitted abstract.

Applicants respectfully request reconsideration of their application in light of the following discussion.

Traversal of Drawing Objection

The Examiner objected to the drawings as not showing the mathematical model recited in claim 3. Applicants respectfully traverse this objection.

Applicants submit that an embodiment of the mathematical model (i.e., a nominal model) is shown in Figs. 1 and 2 of the drawings. A corresponding description of the mathematical model and the method for obtaining such mathematical model is provided on pages 15-23 of the specification.

In view of the foregoing, applicants respectfully submit that the objection to the drawings has been overcome and should be withdrawn.

Brief Summary of the Invention

The present invention is directed to a disturbance estimated-type control system, a gas compressor control system, and a method of designing a disturbance estimated-type control system.

As described in the specification (pages 1-8), conventional disturbance estimated-type control systems have been influenced by parameter variations, including heat load and rotational speed variations, which affect the operation and performance of the control systems.

The present invention overcomes the drawbacks of the conventional art. Figs. 1-5 show an embodiment of a disturbance estimated-type control system according to the present invention embodied in the claims. The disturbance estimated-type control system has a control object 101 (e.g., a gas compressor) based on a mathematical model (shown in Figs. 1-2) comprised of one of a state equation and a transfer function and prepared by system identification technology as described, for example, on pgs. 26-28 of the specification. A disturbance estimating device 109 is based on an expansion system based on the mathematical model and estimates a disturbance 103 of the control object 101 in accordance with an input signal 105 (e.g., a displacement control command value) inputted into the control object 101 and a detection signal 107 (e.g., a detected temperature at the outlet of an evaporator) detected from the control object 101. A compensating device 115 is based on the mathematical model and compensates for a deviation between the detection signal 107 and a target value 111 and outputs a corresponding control

signal. A subtractor 117 subtracts the control signal of the compensating device 115 from a disturbance estimated value of the disturbance estimating device 109.

In other aspects, the present invention is directed to a gas compressor control system and to a method of designing a disturbance estimated-type control system utilizing the mathematical model, disturbance estimating device, and compensating device and corresponding functions described above with respect to the disturbance estimated-type control system.

By the foregoing construction, the disturbance estimated-type control system and the gas compressor control system according to the present invention are insensitive to parameter variations, such as heat load and rotational speed variations, resulting from changes in physical property values. Likewise, by the method according to the present invention, a disturbance estimated-type control system is designed with high efficiency as compared to the conventional art.

Traversal of Prior Art Rejections

Rejections Under 35 U.S.C. §102

Claim 1 was rejected under 35 U.S.C. §102(b) as being anticipated by Iwazawa. Applicants respectfully

traverse this rejection and submit that amended independent claim 1 recites subject matter which is not identically disclosed or described in Iwazawa.

Amended independent claim 1 is directed to a disturbance estimated-type control system and requires a control object based on a mathematical model comprised of one of a state equation and a transfer function and prepared by system identification technology, disturbance estimating means based on an expansion system based on the mathematical model for estimating a disturbance of the control object in accordance with an input signal inputted into the control object and a detection signal detected from the control object, compensating means based on the mathematical model for compensating for a deviation between the detection signal and a target value and for outputting a corresponding control signal, and subtracting means for subtracting the control signal of the compensating means from a disturbance estimated value of the disturbance estimating means. No corresponding structural combination is disclosed or suggested by the prior art of record.

Iwazawa discloses a velocity control apparatus having a control object 16 (e.g., motor), an equivalent disturbance compensator 36, a motor speed compensator 24, and an adder 32 (Fig. 2). However, Iwazawa does not disclose or describe that the control object is based on a mathematical model comprised of one of a state equation and a transfer

function and prepared by system identification technology, as recited in amended claim 1. Likewise, Iwazawa does not disclose or describe disturbance estimating means based on an expansion system based on the mathematical model and compensating means based on the mathematical model, as recited in amended claim 1. In this regard, there is no disclosure in Iwazawa that either or both of the equivalent disturbance compensator 36 and the motor speed compensator 34 are designed in accordance with a mathematical model of the control object 16 (i.e., the motor).

In the absence of the foregoing disclosure recited in amended independent claim 1, anticipation cannot be found. See, e.g., W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) ("Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration"); Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991) ("When more than one reference is required to establish unpatentability of the claimed invention anticipation under § 102 can not be found".); Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added) ("Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim").

Stated otherwise, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. This standard is clearly not satisfied by Iwazawa for the reasons stated above. Furthermore, Iwazawa does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Iwazawa's velocity control apparatus to arrive at the claimed invention.

In view of the foregoing, applicants respectfully request that the rejection of claim 1 under 35 U.S.C. §102(b) as being anticipated by Iwazawa be withdrawn.

Claim 3 was rejected under 35 U.S.C. §102(e) as being anticipated by Szita. Applicants respectfully traverse this rejection and submit that amended independent claim 3 recites subject matter which is not identically disclosed or described in Szita.

Amended independent claim 3 is directed to a method of designing a disturbance estimated-type control system and requires the step of providing a control object, preparing a mathematical model of the control object utilizing system identification technology, the mathematical model comprising one of a state equation and a transfer function. Claim 3 further requires the steps of providing an expanded state equation based on the mathematical model of the control object and a mathematical model of a disturbance, designing from the

expanded state equation a disturbance estimating device for estimating a disturbance of the control object in accordance with an input signal inputted into the control object and a detection signal detected from the control object, designing from the mathematical model of the control object a compensating device for compensating for a deviation between the detection signal and a target value and for outputting a control signal, and subtracting the control signal of the compensating device from a disturbance estimated value of the disturbance estimating device. No corresponding combination of steps is disclosed or described by Szita.

Szita discloses a method for zero acceleration path correction. The method disclosed by Szita provides a control object 106 (e.g., an actuator), an actuator model (see 104 in ZAP processor 205), an estimation disturbance signal 206, and a controller 104. However, Szita does not disclose or describe the step of preparing a mathematical model of the control object utilizing system identification technology, the mathematical model comprising one of a state equation and a transfer function, as recited in amended claim 3. The actuator model disclosed by Szita clearly does not correspond to the mathematical model of the control object recited in claim 3.

Moreover, Szita does not disclose or describe the steps of providing an expanded state equation based on the mathematical model of the control object and a mathematical

model of a disturbance, and designing from the mathematical model of the control object a compensating device for compensating for a deviation between the detection signal and a target value and for outputting a control signal, as recited in amended claim 3. For example, there is no disclosure in Szita that the estimation disturbance signal 206 in Szita is obtained from an expanded state equation based on the mathematical model of the control object and a mathematical model of a disturbance, as recited in amended claim 3.

Since Szita does not disclose or describe the foregoing combination of steps recited in amended independent claim 3, there can be no anticipation by Szita of amended independent claim 3 under 35 U.S.C. §102(e). That is, since each and every limitation of amended independent claim 3 is not found in Szita, the reference does not anticipate the claimed invention. See In re Lange, 209 USPQ 288, 293 (CCPA 1981). Furthermore, Szita does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Szita's method to arrive at the claimed invention.

In view of the foregoing, applicants respectfully request that the rejection of claim 3 under 35 U.S.C. §102(e) as being anticipated by Szita be withdrawn.

Rejection Under 35 U.S.C. §103(a)

Claims 2, 6, 8 and 9 were rejected under 35 U.S.C. §103(a) as being unpatentable over Iwazawa in view of Ijiri. Applicants respectfully traverse this rejection and submit that the combined teachings of Iwazawa and Ijiri do not disclose or suggest the subject matter recited in amended claims 2, 6, 8 and 9.

Amended independent claim 2 is directed to a gas compressor control system and requires a variable displacement type gas compressor having a compression chamber and displacement altering means for altering a displacement of gas in the compression chamber and being based on a mathematical model comprised of one of a state equation and a transfer function prepared by system identification technology. Claim 2 further requires input means for inputting an input signal into the displacement altering means, and detecting means for detecting a detection signal corresponding to one of ambient air temperature, air temperature at an outlet of an evaporator, a flow of a refrigerant flowing through the variable displacement type gas compressor, and a pressure of the refrigerant on a suction side of the compressing chamber. Claim 2 further requires disturbance estimating means based on an expansion system based on the mathematical model for estimating a disturbance of the variable displacement type gas compressor in accordance with the detection signal detected by the detecting means and the input signal input into the

displacement altering means, compensating means based on the mathematical model for compensating for a deviation between the detection signal and a target value and for outputting a corresponding control signal, and subtracting means for subtracting the control signal of the compensating means from a disturbance estimated value of the disturbance estimating means. No corresponding structural combination is disclosed or suggested by the prior art of record.

Iwazawa discloses a velocity control apparatus having a control object 16 (e.g., motor), an equivalent disturbance compensator 36, a motor speed compensator 24, and an adder 32 (Fig. 2). However, Iwazawa does not disclose or describe a control object (i.e., a variable displacement type gas compressor) based on a mathematical model comprised of one of a state equation and a transfer function prepared by system identification technology, disturbance estimating means based on an expansion system based on the mathematical model, and compensating means based on the mathematical model, as recited in amended claim 2, as set forth above for the rejection of claim 1 under 35 U.S.C. §102(b).

The secondary reference to Ijiri has been cited by the Examiner for its disclosure of controlling a variable displacement gas compressor. However, Ijiri clearly does not disclose or suggest a variable displacement type gas compressor based on a mathematical model comprised of one of a state equation and a transfer function prepared by system

identification technology, disturbance estimating means based on an expansion system based on the mathematical model, and compensating means based on the mathematical model, as recited in amended claim 2. Since Ijiri does not disclose or suggest these structural features recited in amended independent claim 2, it does not cure the deficiencies of Iwazawa. Accordingly, one ordinarily skilled in the art would not have been led to modify the references to attain the claimed subject matter.

Claim 6 depends on and contains all of the limitations of amended independent claim 2 and, therefore, distinguishes from the references at least in the same manner as claim 2.

Claims 8-9 have been amended to depend on amended independent claim 1. The combined teachings of Iwazawa and Ijiri do not disclose or suggest the structural combination of the disturbance estimated-type control system recited in claim 1, including a control object based on a mathematical model comprised of one of a state equation and a transfer function and prepared by system identification technology, disturbance estimating means based on an expansion system based on the mathematical model, and compensating means based on the mathematical model, as set forth above for amended independent claims 1 and 2. Claims 8-9 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from the references at least in the same manner as claim 1.

In view of the foregoing, applicants respectfully request that the rejection of claims 2, 6, 8 and 9 under 35 U.S.C. §103(a) as being unpatentable over Iwazawa in view of Ijiri be withdrawn.

In view of the foregoing amendments and discussion, the application is believed to be in allowable form. Accordingly, favorable reconsideration and allowance of the claims are most respectfully requested.

Respectfully submitted,

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October 1, 2004
Date